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DEC 16 2004

UTILITY PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICEIn re application of: **FACINELLI, et al.**

Group Art Unit: 3617

Serial No.: 10/664,318

Examiner: Basinger, S.

Filed: Sept. 16, 2003

For: **WATERJET PROPULSION APPARATUS**

Attorney Docket No.: H0004341

CERTIFICATE OF MAILING UNDER 37 C.F.R. § 1.8(a)

I hereby certify that this correspondence is being transmitted by facsimile on the date shown below to the United States Patent and Trademark Office at (703) 872-9308.

on

Dec. 16, 2004

Signature:



Ivan J. Mlachak

DECLARATION UNDER 37 C.F.R. §1.132

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-145

Commissioner:

I, William Facinelli, being duly sworn, depose and state as follows:

1. My name is William A. Facinelli. I am 51 years old and fully competent to make this affidavit. My educational background includes a Ph.D. in Mechanical Engineering from Arizona State University in 1983. My work experience includes 22 years with Honeywell and its predecessor companies. During this time I have been significantly involved in marine propulsion design for approximately 8 years. This work has included significant efforts in the field of waterjet systems.

2. Based on my education and work experiences I am qualified to provide this affidavit. I am a named inventor of US Patent Application No. 10,664,318 "WATERJET PROPULSION APPARATUS" (referred to herein as the '318 application). I have reviewed and am familiar with the patent examiner's office action mailed Sept. 20, 2004. I have also reviewed the Broinowski patent (U.S. Patent no. 6,027,383), which was cited by the patent examiner, and I am familiar with its contents.

3. In June 2000 I began work on a design project for Honeywell International. The design project related to an Expeditionary Fighting Vehicle (EFV) for the US Marine Corps. In particular, Honeywell was acting as a subcontractor for the general contractor, General Dynamics. The Honeywell team, of which I was a member, was responsible for designing a propulsion system for the EFV. As part of Honeywell's propulsion design, Honeywell further contracted with the Band, Lavis, and Associates Company in Severna Park, Maryland. In particular, I worked with Mr. Alan J. Becnel and Mr. John G. Purnell, who are co-inventors of the '318 patent application.

4. An EFV, to generally describe it, is an amphibious troop-carrying vehicle that is used by the Marine Corps for assaulting beaches. The EFV must operate on both land and sea. The vehicle is generally large and heavy, particularly when loaded; however, the specification calls for sufficient power to enable the vehicle to get on plane and then accelerate to high speeds. The waterjet design related to propulsion of the EFV in water.

5. Previous propulsion designs of the EFV suffered from drawbacks. The previous EFV was limited in that the waterjet could not absorb sufficient power from the engine to enable the vehicle get on plane with the desired load. If the EFV cannot get on plane, then it cannot achieve the high speeds required for rapid troop deployment.

6. In our design process we used the EFV specifications for vehicle speed at which it should get on plane and for available horsepower, and also designed a unit that would fit within the same envelope as the existing waterjet. The design process differed from previous processes in that it made use of state-of-the-art computer programs that model flow dynamics. The key design computer program did not exist during the time that the Broinowski patent was filed.

7. The design suggested by these programs dictated features such as the number of rotor blades, the number of stator blades, as well as the rotor blade/housing clearance. The rotor blade/housing clearance, an important feature in this design, is not something that a designer for this kind of application would arrive at solely based on considerations about materials, diameters, and manufacturing precision, as suggested by the examiner. These considerations would encourage a design with a large rotor/housing clearance, with no clear

incentive for a relatively small value. Rather, the clearance is chosen as it relates to the above issues and also performance in particular efficiency.

8. Efficiency of the waterjet is linked to the clearance between the rotor blade and the housing. It would be difficult to detect performance differences without an accurate computer program. We arrived at our clearance specification by undertaking computerized flow analysis. When we increased the clearance, it degraded efficiency. On the other hand, if we decreased clearance, it increased the risk that the rotor would rub against the housing. The motivation to set the claimed clearance came from these suggestions of the flow analysis.

9. The specification of other features of the waterjet also arose from a contemporary computer analysis. The precise flow path (the shapes of the hub and of the housing), the area of the blades, the loading distribution on the blades, and the pressure rise induced by the waterjet were all determined by this kind of analysis.

10. Examples of design criteria that were developed by flow analysis and computer modeling are attached hereto.

11. The motivation to redesign an existing waterjet is not straightforward. A designer cannot start from a known design and "scale up" so as to increase power. Cavitation is a significant consideration for waterjet designs, especially designs attempting to reach the powers in our application. Further, it was desired to obtain a design that functioned well at a relatively low RPM. A successful rotor/stator design in waterjet applications thus involves a compromise of several considerations. It would not have been obvious to modify the Broinowski reference to achieve the desired result. We were trying to advance the state of the art. Something done ten years ago was not deemed relevant. For example, previously, engineers would have begun a design process assuming a uniform loading on the rotor blades. Our analysis did not make that assumption. The analysis led us to incorporate a non-uniform loading into our design.

12. In my opinion, the results achieved by the waterjet design would have been unexpected given the prior state of the art. I say this in view of the advance in waterjet performance achieved by our design, as compared to known designs.

13. Our waterjet propulsion system has also received praise and recognition from others in the industry.

14. Our invention has received various forms of recognition by others in the industry. In particular, Mr. John W. Wosina, Vice President of Amphibious Systems with General Dynamics authored the letter attached to this Affidavit. In paragraph 3 of that letter, Mr. Wosina refers to the waterjet invention as "an especially noteworthy contribution." The letter further states "The timeliness and quality of the solution provided significantly reduced a key water performance risk..." I read these comments to represent praise and recognition by those who would be qualified to evaluate the invention.

15. Other examples of praise and recognition come from various members of the US Marine Corps. I refer to emails attached hereto. The full email series conveys the excitement and emotion that the test of the EFV generated. Individual Marine Corps operators compared the vehicle propelled by the previous design to the one propelled by the invention as "a model T to a Lamborghini". (I also note that this was a comment made by one of the "most experienced" Marine Corps operators.) Another said the vehicle "turns like a jet ski." Still another comment received during a testing debriefing was "night and day different than the [previous] design in speed and acceleration, a 100% improvement."

16. I interpret these comments, which relate to the vehicle's acceleration and power, as being indicative of the success of the waterjet design, as opposed to other features of the EFV that are not the subject of the patent application.

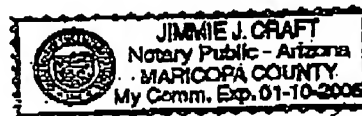
William A. Facinelli
William A. Facinelli

Dated: Dec. 16, 2004

Subscribed to and sworn before me this 16 day of DEC, 2004

NOTARY:

Jim J. Craft



Design of Experiments for HEWJ

4 factors, 9 runs

<u>Run</u>	<u>Clearance (in)</u>	<u>Spacing (in)</u>	<u>Profile (in)</u>	<u>Finish (micro-in)</u>
1	0.05	1	-0.03	80
2	0.15	1	-0.03	125
3	0.05	3	-0.03	125
4	0.15	3	-0.03	80
5	0.05	1	0.03	125
6	0.15	1	0.03	80
7	0.05	3	0.03	80
8	0.15	3	0.03	125
9	0.1	2	0	102.5

Design of Experiments for HPWJ				
3 factors, 5 runs				
Run	Radial clearance (In)	Profile (In)	Roughness (micro-in)	Rotor efficiency
1	0.05	-0.030	125	0.937
2	0.15	-0.030	80	0.920
3	0.05	0.030	80	0.938
4	0.15	0.030	125	0.918
5	0.10	0	102.5	0.928

Design of Experiments for HEWJ

3 factors, 9 runs

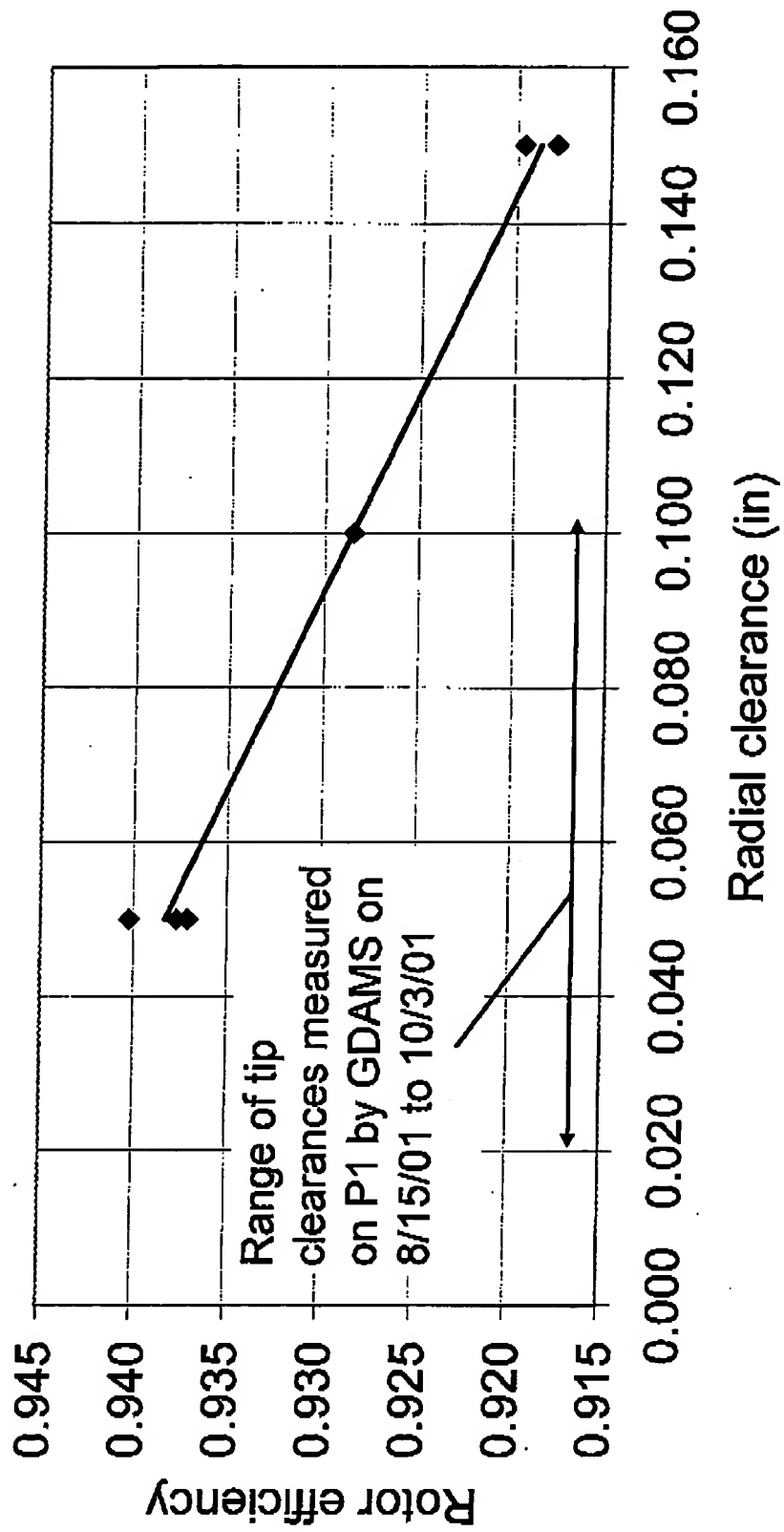
<u>Run</u>	<u>Clearance (in)</u>	<u>Profile (in)</u>	<u>Finish (micro-in)</u>
1	0.05	-0.030	80
2	0.15	-0.030	80
3	0.05	0.030	80
4	0.15	0.030	80
5	0.05	-0.030	125
6	0.15	-0.030	125
7	0.05	0.030	125
8	0.15	0.030	125
9	0.10	0	102.5

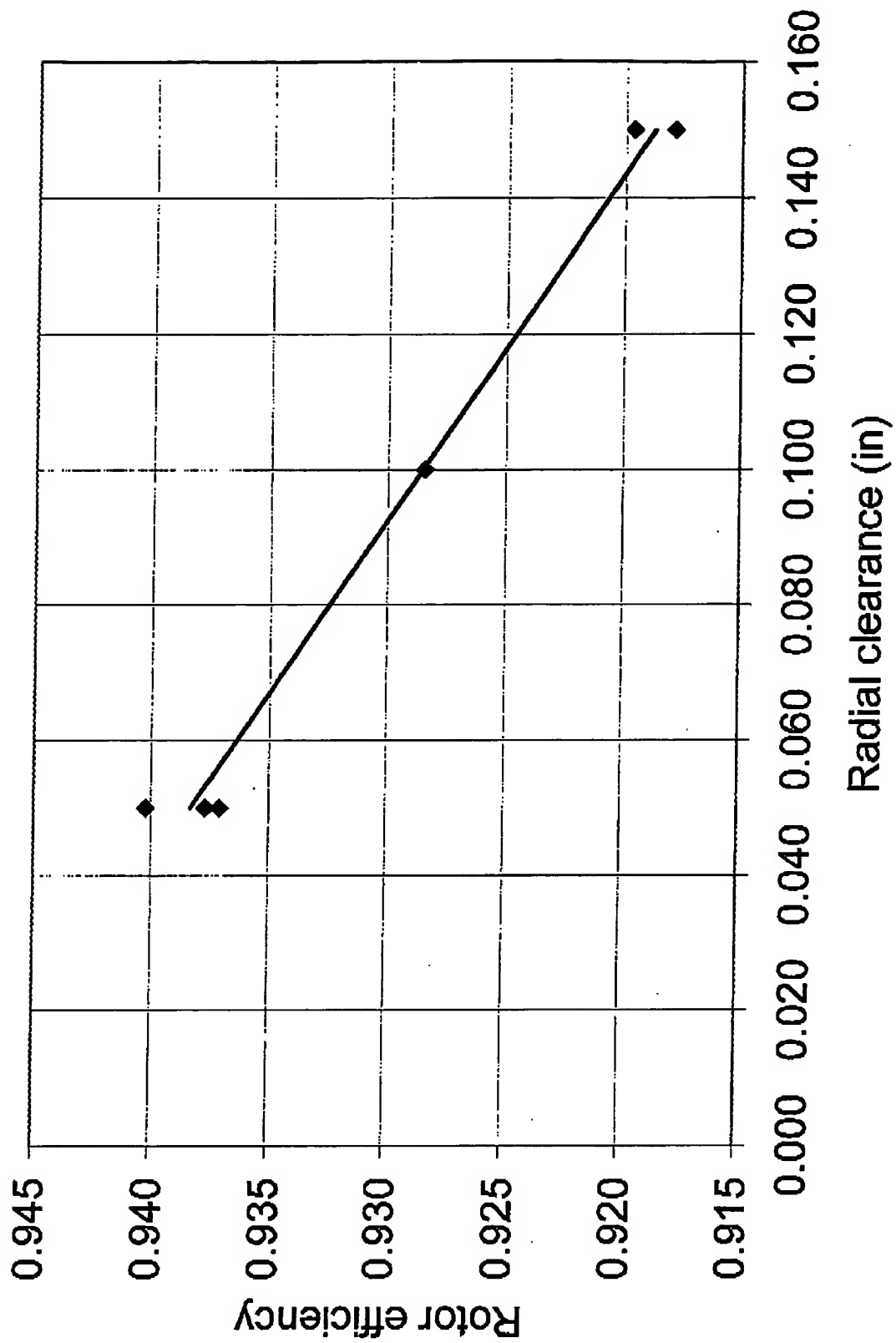
Design of Experiments for HPWJ				
Roughness analysis				
Run	Radial clearance (in)	Profile (in)	Roughness (micro-in)	Rotor efficiency
1	0.05	-0.030	125	0.9371
3	0.05	0.030	80	0.9377
6	0.05	-0.030	750	0.9239
7	0.05	0.030	750	0.9228
8	0.05	-0.030	400	0.9302

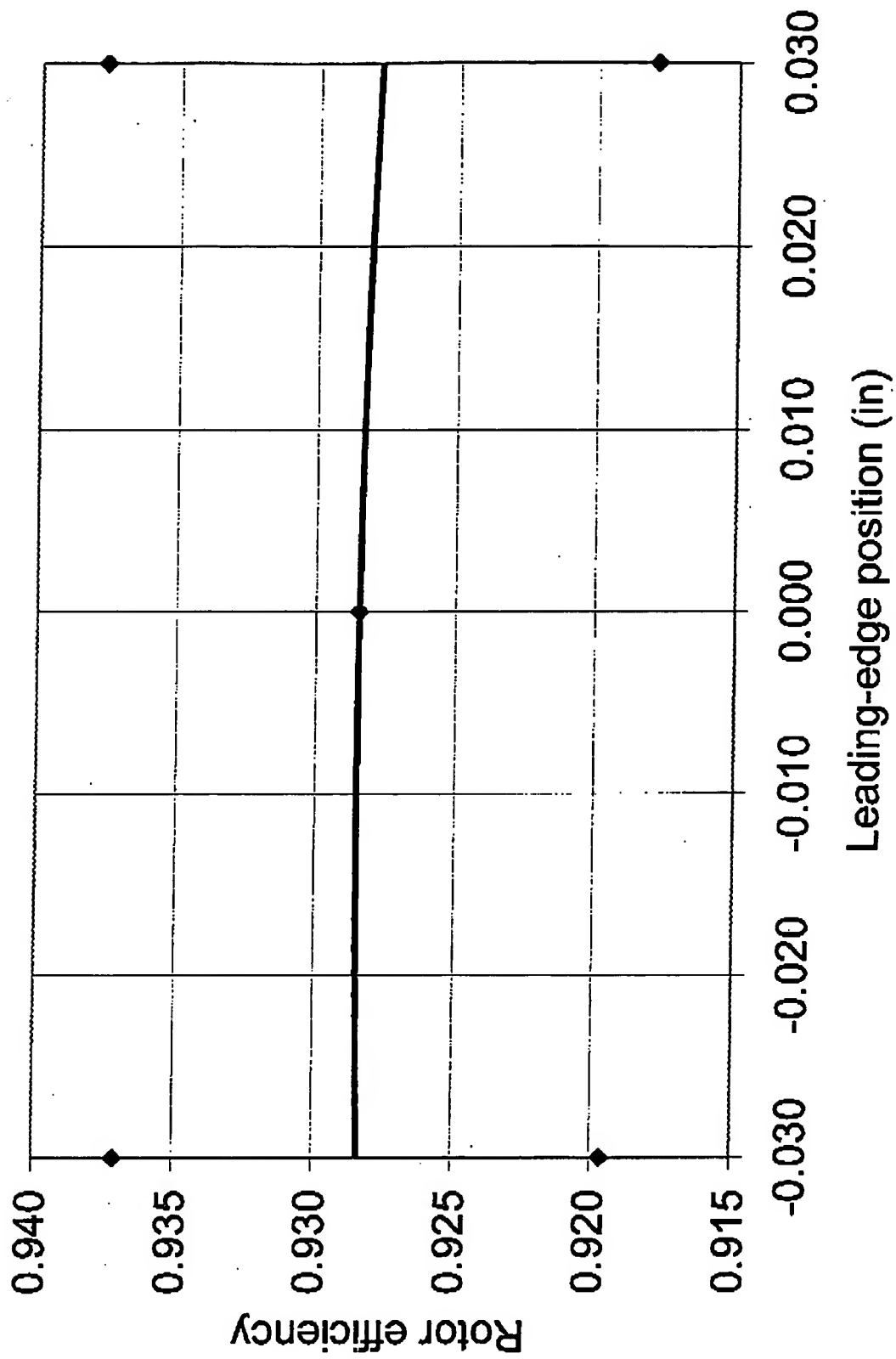
12/14/2004

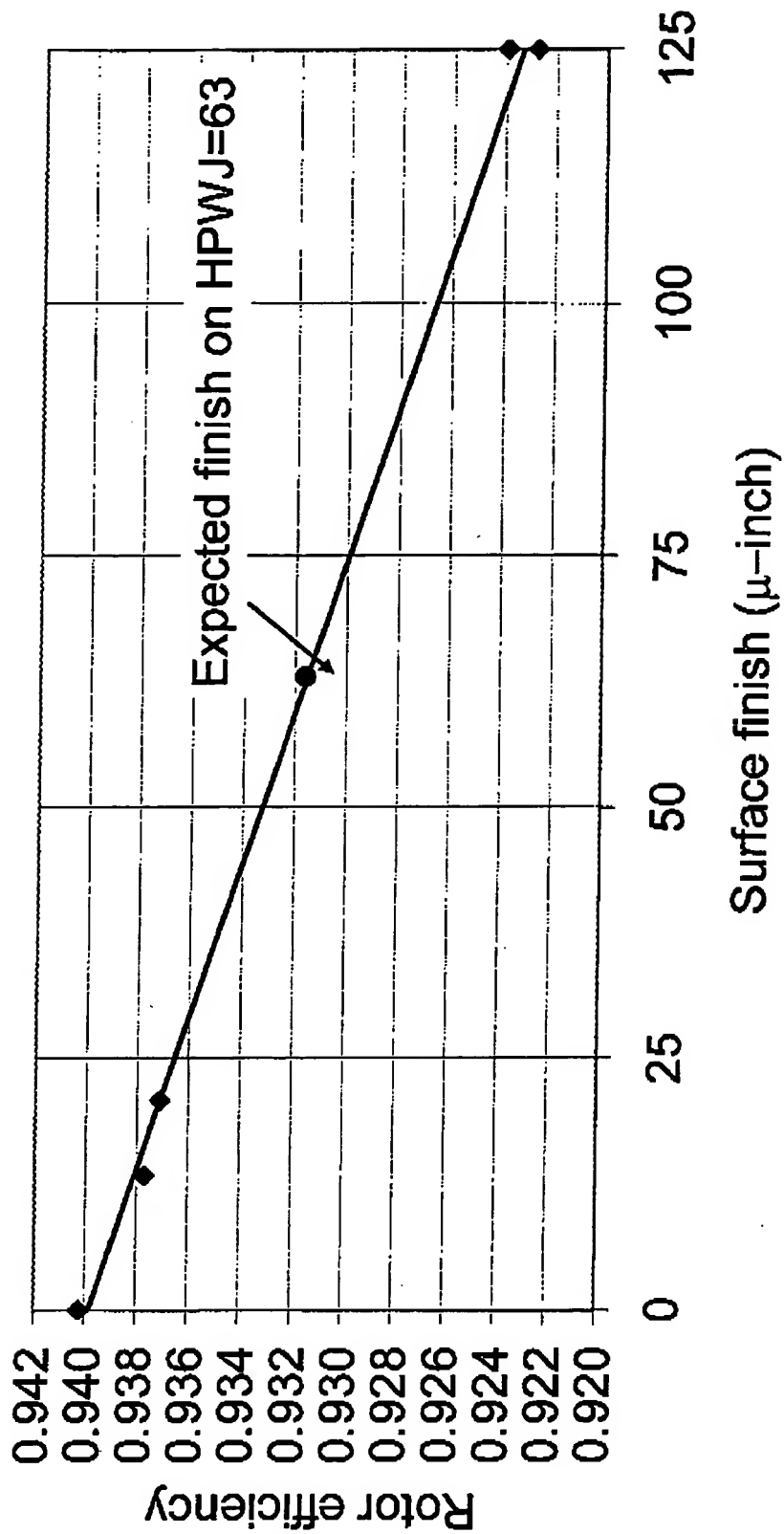
All DOE-related runs									
Rotor efficiency terms:									
Constant									
Clearance coeff									
Finish coeff									
	Radial	Profile (in)	Roughness (micro-in)	Surface finish (micro-in)	Head rise (ft)	Rotor efficiency	Calc'd efficiency	Delta^2	
Run	clearance (in)								
1	0.05	-0.03	125	20.83	103.109	0.93709	0.93715	3.43119E-09	
2	0.15	-0.03	80	13.33	97.51	0.91963	0.9193	1.06585E-07	
3	0.05	0.03	80	13.33	102.509	0.93769	0.93815	2.07955E-07	
4	0.15	0.03	125	20.83	96.808	0.91789	0.91831	1.73125E-07	
5	0.1	0	102.5	17.08	100.109	0.92845	0.92823	5.01528E-08	
2h	0.05	0	0	0	103.2	0.94022	0.93992	9.04473E-08	
6	0.05	-0.03	750	125	101.963	0.923925	0.9233	3.96672E-07	
7	0.05	0.03	750	125	101.193	0.92275	0.9233	2.97222E-07	
Runs with clearance=0.05 (to show effect of finish)									
Run			Roughness (micro-in)	Surface finish (micro-in)	Head rise (ft)	Rotor efficiency			
1			125	20.83	103.109	0.93709		63	0.9316
3			80	13.33	102.509	0.93769			
2h			0	0	103.2	0.94022			
6			750	125	101.963	0.923925			
7			750	125	101.193	0.92275			
Matrix for tech paper									
Run	Radial	Profile (in)	Surface finish (micro-in)	Rotor efficiency					
(Design)	clearance (in)								
1	0.05	0.00	0.0	0.940					
2	0.05	-0.03	20.8	0.937					
3	0.15	-0.03	13.3	0.920					
4	0.05	0.03	13.3	0.938					
5	0.15	0.03	20.8	0.918					
6	0.1	0.00	17.1	0.928					
7	0.05	-0.03	125.0	0.924					
	0.05	0.03	125.0	0.923					
Sum-squares									
									1.32559E-06

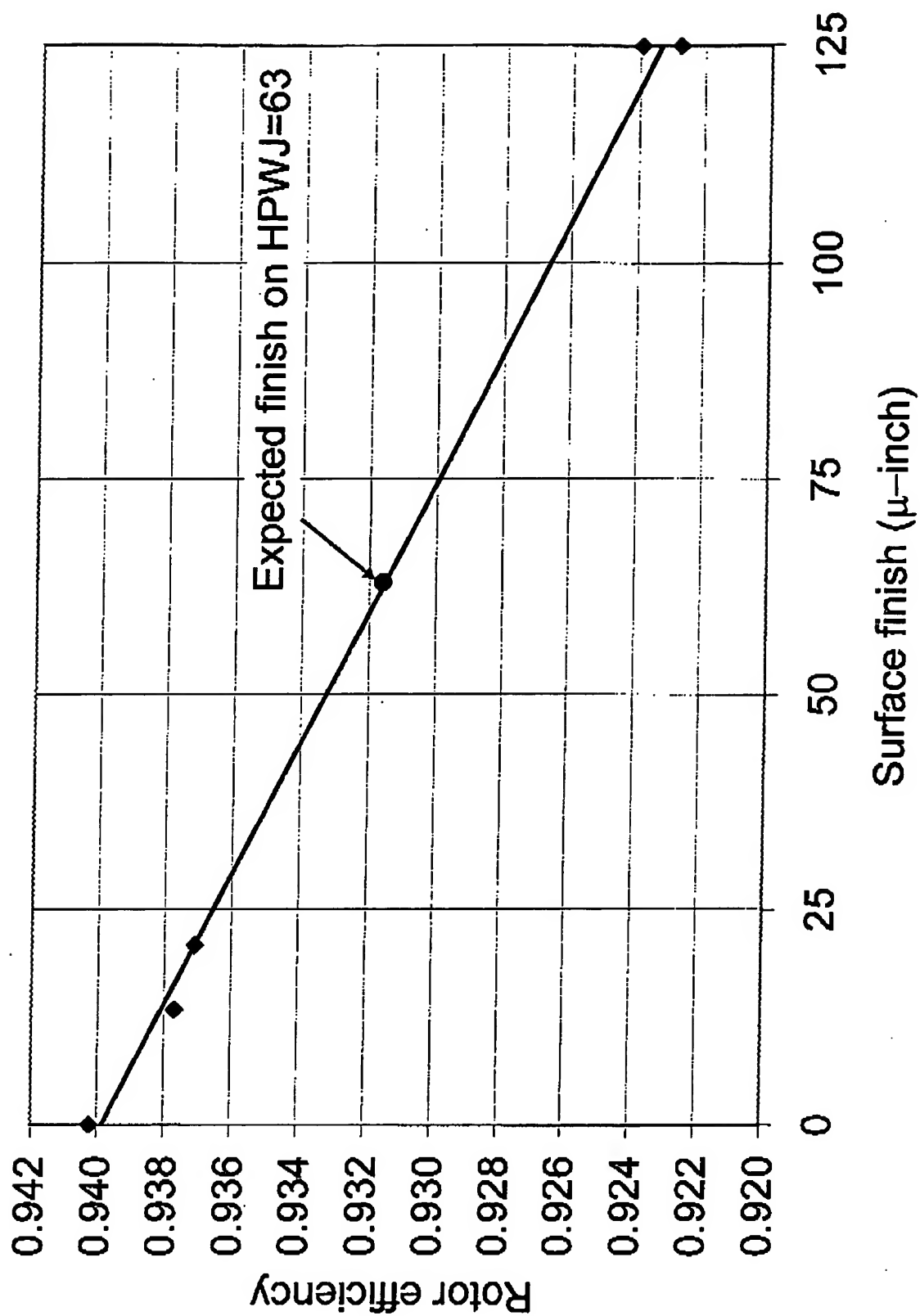
DOEandfinish - All runs



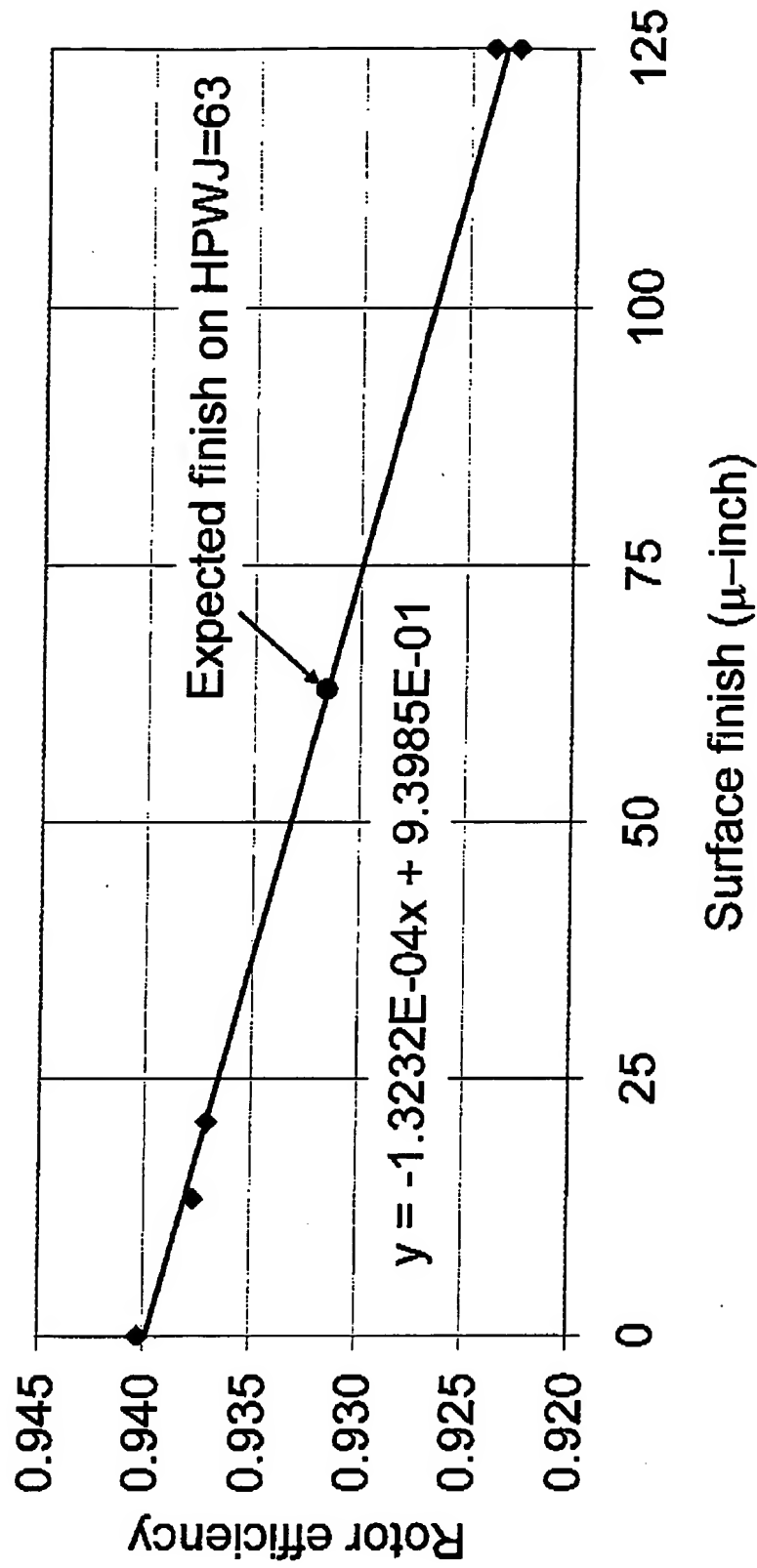








HPWJ rotor efficiency vs. surface finish from DOE and extra runs



DOE and finish - Eff vs finish w trendline fit

12/14/2004

Finish vs. clearance to meet thrust req't**Using "spec" thrust value of 11949**

<u>Cl</u>	<u>Fin</u>
0	83.7
0.05908	0
0.15	-128.82

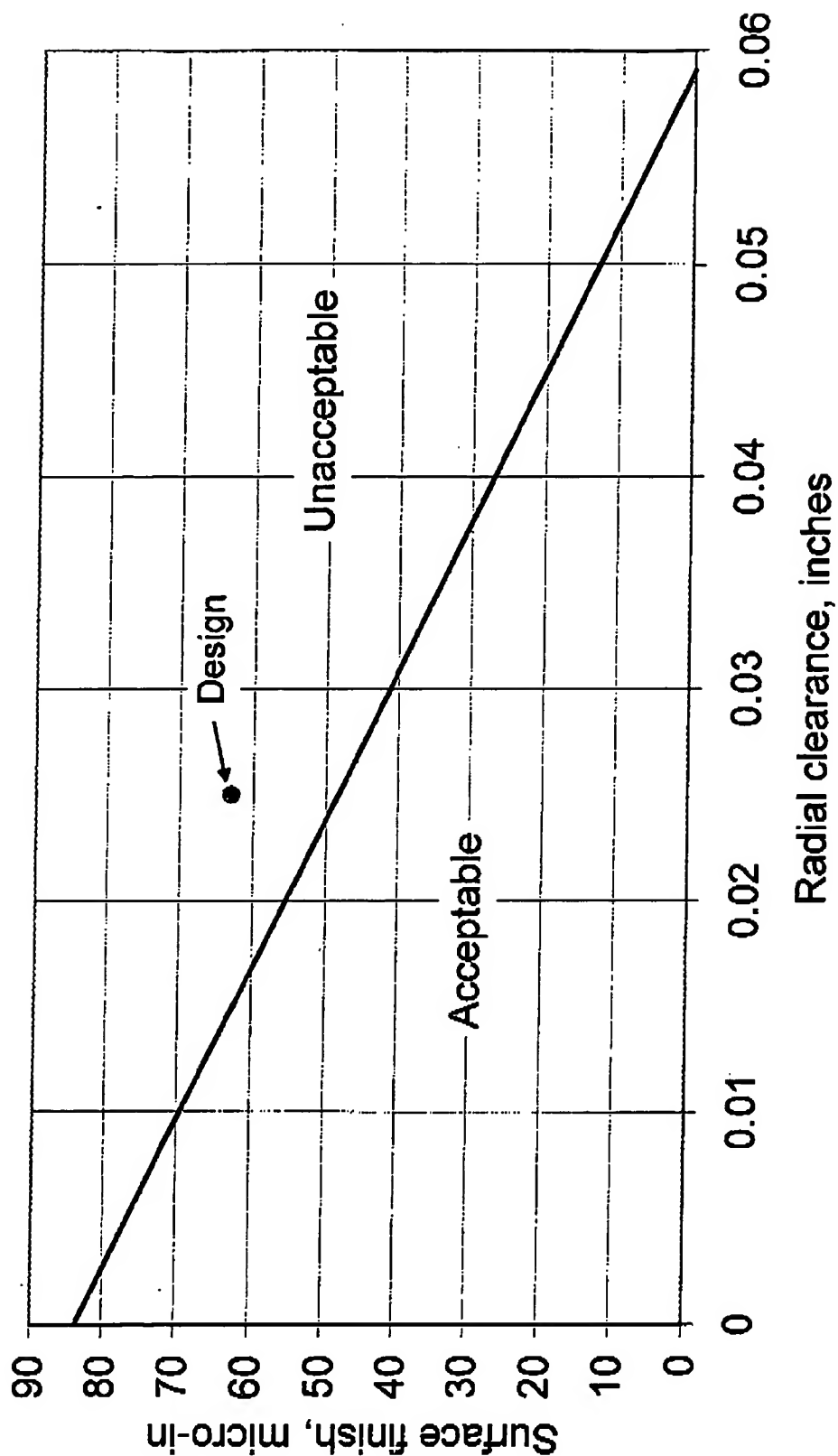
Using thrust value of 11203 from Alan's 2002 table, at 13.9 knots and 1114 rpm

<u>Cl</u>	<u>Fin</u>
0	712.2
0.50268	0

Design point

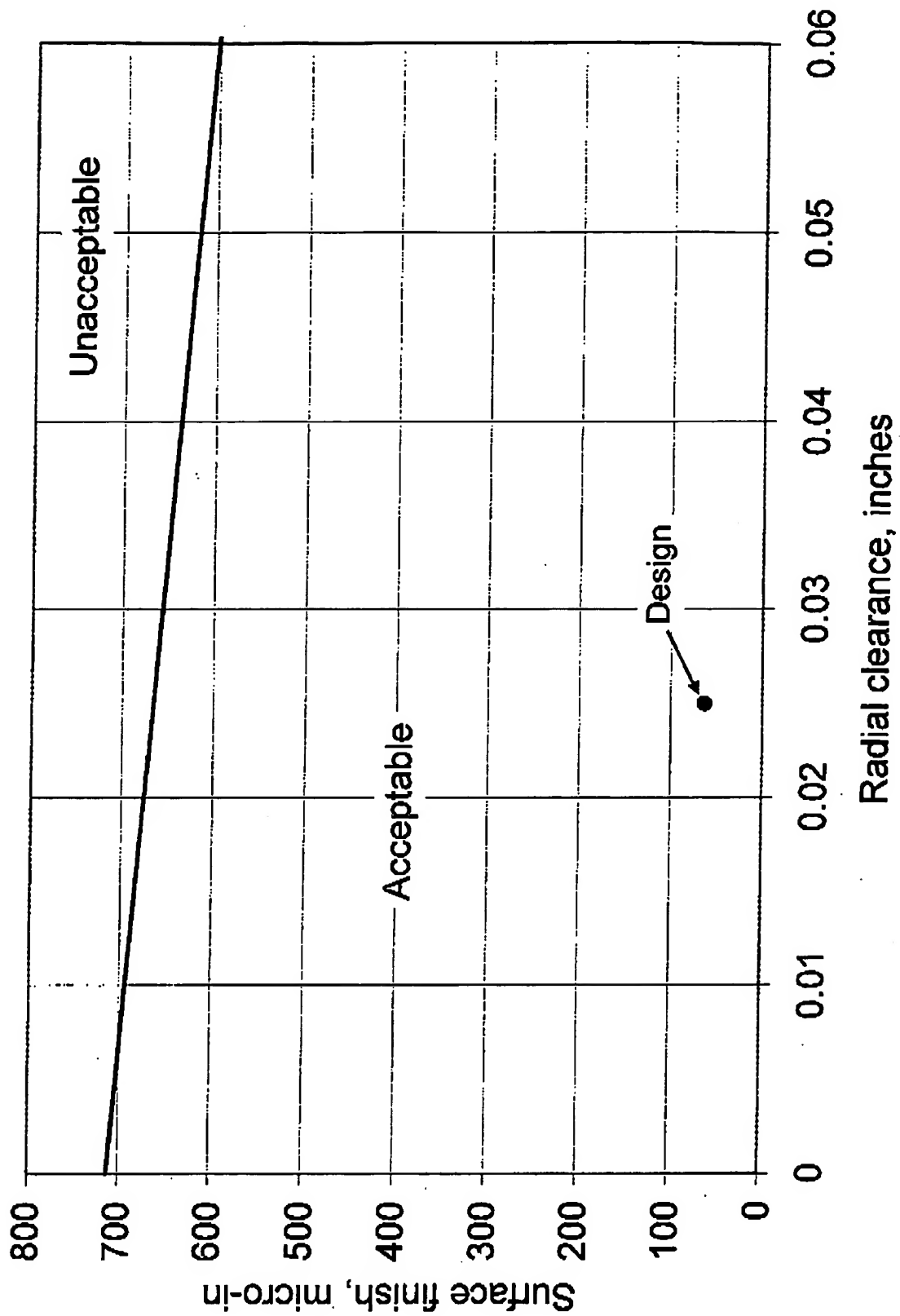
0.025	63
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Combinations of surface finish and clearance to give 11949 lbf thrust from HPWJ



DOEandfinish - Finish vs. cl - chart

12/14/2004



DOEandfinish - Finish vs. cl - chart for DFSS

12/14/2004

GENERAL DYNAMICS
Amphibious Systems

25 October 2004

Ms. Adriane Brown
Vice President and General Manager
Honeywell Engine Systems and Accessories
1300 W. Warner Road
Tempe, AZ 85284

Subject: Expeditionary Fighting Vehicle (EFV)
Letter of Appreciation to Honeywell EFV Program Personnel

Dear Ms. Brown:

I am writing on behalf of General Dynamics to express my sincere gratitude and appreciation for the outstanding contributions made by Honeywell to the USMC's Expeditionary Fighting Vehicle program. Honeywell's involvement in EFV dates back to the early days of the program when it partnered with GD and accepted the challenging responsibility of designing and developing a state-of-the-art Water Propulsion System.

Over the course of these last eight (8) years, there have been numerous occasions where dedicated Honeywell personnel were called upon to apply their significant expertise and energy to make the dream of high speed amphibious technology become reality. The weight, volume, reliability, maintainability, integration, cost and performance considerations were optimized with the highest standard of professionalism and best-in-class processes.

An especially noteworthy contribution relates to the Counter-Rotating Water Jet design that was requested in late 2003 and delivered by Honeywell by early 2004. The timeliness and quality of the solution provided significantly reduced a key water performance risk and positioned the program for a very successful Operational Assessment.

Again, I would like to thank the Honeywell leadership and all Honeywell personnel who have participated in delivering such a superb solution for the EFV.

Semper Fidelis,


John W. Wosina
Vice President, Amphibious Systems

14041 Worth Avenue
Woodbridge, VA 22192
Tel: 703-492-3218
Fax: 703-492-3100
www.gdls.com

From: Gray, Brad
Sent: Wednesday, March 31, 2004 7:06 AM
To: Phillips, Jeff; Hill, Timothy
Cc: Henry, Ken; Brown, Adriane M.; Wojciehowski, Jim; Overholt, David
Subject: RE: EFV Test 29 Mar 04

Jeff,

This is fantastic news for Honeywell and the EFV program. Not only did we deliver hardware in meeting a very aggressive schedule, we delivered performance we predicted. I like the quote below; "the difference between P1 and E2 is like a Model T to a Lamborghini".
Impressive

Tim,

Please get with Jeff Phillips. I would like to publish this exciting accomplishment for Honeywell, the Space, Missile and Marine Product Line and the EFV Team.

-----Original Message-----

From: Phillips, Jeff
Sent: Tuesday, March 30, 2004 5:49 PM
To: Henry, Ken; Gray, Brad
Subject: FW: EFV Test 29 Mar 04

Just wanted to pass this on. This is the report from Camp Pendleton on the first day of high speed testing of the EFV vehicle with the new Honeywell High Power Waterjet design. The E2 vehicle is the first to enter the water with the new waterjets. The PDRR vehicle they refer to used a waterjet design adapted from a Navy lab waterjet design. This is outstanding news for our team and a big boost to see the end user (U.S. Marines Corps) this excited about what we have given them by improved performance of our product.

Regards, Jeff

-----Original Message-----

From: newcombw@gdls.com [mailto:newcombw@gdls.com]
Sent: Tuesday, March 30, 2004 12:51 PM
To: Corcino, Dave; Phillips, Jeff; Tarabori, Steve; Susan.Hobbs@Honeywell.com
Cc: Bonds@gdls.com; zichc@aaav.usmc.mil; RingG@aaav.usmc.mil; moyerd@gdls.com
Subject: Sitrep--29 Mar 04

Great news. See the initial report on EFV Hi-speed testing. Much appreciate is in order for each Honeywell EFV team member, as well as the WTR-HPWJ test team, in the development, designing, testing, and building of the Honeywell High-Power Waterjet.

Bill Newcomb
General Dynamics Amphibious Systems
Ph: 703.490.0156
Fax: 703.490.6098

----- Forwarded by David W Moyer/GD_AAAV/GDAS on 03/30/2004 07:14 -----

Jeff C Lamb

C-Level IPT Leads, D-Level IPT Leads, John
03/30/2004 07:07

To: B-Level IPT Leads,
W Wosina/GD_AAAV/GDAS@GDAS
cc:
Subject: Sitrep--29 Mar 04

Team:

I think this is one of the best SITREPs we have seen in the past few months. The highlights are E2 conducted High Water Speed testing last night and the test crew's comments about the performance were promising. More to follow in the test log which should be out later this morning.

FYI,

Jeff C. Lamb
Test and Evaluation IPT Lead
Office 703-490-7567
Cell 571-436-5861

----- Forwarded by Jeff C Lamb/GD_AAAV/GDAS on 03/30/2004 07:04 -----

Fontenot Maj Mark T

<FontenotMT@pendleto
David L <ReevesDL@pendleton.usmc.mil>, Howard
n.usmc.mil>
<howardj@aaav.usmc.mil>, Paquette GS-15 Marc G
<PaquetteM@aaav.usmc.mil>, "'lambj@gdls.com'" <lambj@gdls.com>,
03/29/2004 21:41 Delmonico GS-15 Mark J
<delmonicom@aaav.usmc.mil>
cc:
Subject: Sitrep--29 Mar

04

Gents

Just wanted to start your day off with some very good news. Below you will find Capt Moretti's SITREP that details E2 reaching high water speeds. We are trying to get a video out to Woodbridge today because the words alone are not enough to describe just how amazing E2 performed.

During the Op debrief, I asked the crew to characterize the performance. One of the most experience drivers (Rodger) said the difference between P1 and E2 was like a Model T to a Lamborghini. Observers on the RHIB said E2 turns like a jet ski.

It is an amazing sight to see this vehicle jump right out of the water and get on plane. It's days like this that we can't believe we are getting paid to do this.

R/S
Maj Fontenot.

-----Original Message-----

From: Moretti Capt John A
Sent: Monday, March 29, 2004 6:23 PM
To: Reeves LtCol David L
Cc: Fontenot Maj Mark T; Benzie Mr John F; Wright GS 12 William N; Oyama
Van

Subject: Sitrep--29 Mar 04

Sir,

It was an unbelievable day for E-2 at AVTB today. We had a test plan for high water speed characterization for E-2. The vehicle was in LC 1, weighing 70,540 pounds. The sea state was flat (low sea state 1). When we initially got in the water, the EFV blew its port hydraulic distribution manifold cover. After the crew cleaned up the mess and replaced the entire distribution manifold, we got back into the water. The initial plan was to bring E-2 up to full throttle, then step the transom down from +13 to planing speed, taking 30 second data collects for each transom setting. That plan went out the window with what we saw next. E-2 reached planing speed at +8 on the transom. In the past it would take the PDRR vehicle several steps on the transom to get on plane. The transom angle was somewhere around +2 or 0 degrees before the PDRR vehicle would make planing speeds. Today E-2 reached planing speeds in a fraction of that time at a transom setting of +8. I had to stop the test in the middle of the first run. We have the video, but I'll give you a short explanation of what I saw. E-2 had pitched up to the point that the bow was entirely out of the water. The transom was stepped down to +10 with no visual effect. Then the transom was stepped down to +8. The EFV launched itself out of the water and came up on plane. The vehicle speeds that were called out of the radio went from 13 knots, to 21 knots, to 28 knots, to 30+ knots. E-2 accelerated so fast that I had to call all stop; I wasn't sure if lowering the transom would actually slow it down. It is clear in the video that for most of the first run, the bow was out of the water. We adjusted the test plan to allow the driver to get up to planing speed stepping the transom down at his own discretion. The driver reported that he could maintain 27 knots at a transom of 0 degrees. During the next couple of runs the EFV came up on plane in about a minute. We then set up to execute some port 180 degree turns. The turns were executed at full steer input from the driver. One of the turns was executed sharper than anyone of the test team had ever seen. The data trailer reported that the vehicle actually accelerated through one of the turns without ever slowing down. The turning radius for that turn was unbelievably tight. During one of the starboard 180 turns, the vehicle actually came off plane and got into a steep port list that resulted in a plow-in condition. After calling all stop, I had the divers check out the vehicle. They reported that everything looked good; there was no physical abnormality that would have caused the sharp port list or the plow-in. In the after action it was mentioned that the driver (in the past) had usually bumped up the transom before turning, but he did not do that today. That is a likely cause of the vehicle digging in on one side, then plowing in. The vehicle crew mentioned in the debrief that the SDD design is "night and day" different than the PDRR design in speed and acceleration, a "100% improvement."

Path Forward: Repeat today's test at LC 3.

E-7 is waiting on parts and other maintenance issues.

Path Forward: Continue to drive the maintenance effort so that it can conduct some land testing by the end of the week.

r/s,
Capt John A. Moretti
Operations Officer
Amphibious Vehicle Test Branch
Box 555217
Camp Pendleton, Ca 92055-5217
(760) 763-1897